# *Yukon Green Power Initiative*
# *Draft Implementation Strategy*

## *Background Papers*

To support stakeholder and public review of the Draft Green Power Implementation Strategy, the Yukon Development Corporation has prepared seven background papers. These papers summarize the research undertaken in preparing the draft strategy.

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| Background Paper #1 | Defining Yukon Green Power |
| Background Paper #2 | Challenges and Opportunities for Green Power – A Yukon Perspective |
| Background Paper #3 | Green Power Education |
| Background Paper #4 | Research and Development |
| Background Paper #5 | Green Power Installation (Supply) |
| Background Paper #6 | Green Power Marketing and Incentives |
| Background Paper #7 | Green Power Initiative - References |

***Spring 1999***

***Yukon Development Corporation***

# *Defining Yukon Green Power*

***Background Paper #1***

Green Power or green energy is generally defined as electricity that is produced from renewable sources in an environmentally sustainable manner. The final report of the ***Yukon Cabinet Commission on Energy*** defines sustainability in the context of an energy policy as:

> "Energy production, distribution and use that does not compromise:
> - the ability of future generations to produce and use energy;
> - the health of the environment, and;
> - future availability of efficient, secure, reliable and affordable
> - energy supplies."

Green energy resources and technologies minimize, or do not result in:

- greenhouse gas emissions;
- local or regional air quality impacts;
- impacts on watersheds, river systems, and landscapes; or
- an increase in levels of toxic wastes.

Green power is a component of green energy that relates to electricity. Definitions of what constitutes 'green' differ between jurisdictions and individuals, with some lists being more inclusive. Most definitions of green power include the following as a core set:

- hydro – environmentally benign hydro-electricity technologies that are small enough to minimize incremental environmental impacts, and that specifically:
- protect aquatic organisms or mitigate impacts on them,
- should not include hydro with large tracts of flooded lands, and;
- do not significantly alter water flow patterns.
- wind – individual turbines and wind farms
- solar – solar photo-voltaic technologies that produce electricity and solar heating technologies that offset electrical loads (i.e. solar water pre-heat for electric boilers or space heating); and
- bio-mass – solar energy that is stored in green plants and other organic material is referred to as bio-mass – bio-mass facilities burn wood, agricultural wastes and/or methane gases from landfills to spin a turbine that then generates electricity.

Other potential forms of Green Power include:

- hydrogen – fuel cells that generate electricity through a chemical reaction involving hydrogen gas, demonstrating 'green' attributes if the hydrogen is derived from a sustainably managed energy resource;
- tidal (not applicable to Yukon); and
- geothermal – environmentally-benign electricity generation facilities that utilize heat energy from the earth, including ground-source heat pumps and steam turbines powered by geothermal steam.

Technologies that generate electricity from waste, which itself should be minimized in the pursuit of sustainable resource management, are nonetheless sometimes suggested as being included as Green Power because the alternative waste management modes have a greater environmental impact:

- co-generation – optimizing the use of fossil fuels, thereby substituting for other sources – making them relevant from some perspectives;
- landfill – collection of landfill methane for use in a steam turbine or combustion turbine to generate electricity or co-generate electricity and heat (see above – bio-mass);
- sewage – collection of sewage gas for the generation of electricity; and
- waste fuels from oil and gas operations – collection and combustion of waste gases for electricity from the natural gas and oil industries resulting from the collection, transport, and/or processing of fossil fuels.

Conventional technologies that are based on renewable resources, but are done at such a large scale that they are no longer generally considered to qualify as "green power" include:

- hydro – hydro-electric mega-projects involving large dams and tracts of land flooded for reservoirs; and
- other – any mega-project where there are significant associated environmental impacts due to, for example, single use of large tracts of land.

In Canada, many jurisdictions and hydro utilities take the position that hydro developments are by definition, renewable and therefore constitute a valid source of 'green power'. Australia provides another example of a jurisdiction that takes this position. In Australia, hydro from existing dams is included in the definition of Green Power. While there is some debate in Canada regarding whether large-scale hydroelectric developments fit under the definition of renewable energy, there is no disagreement that smaller projects of up to 20 MW are included.

Conventional technologies from non-renewable resources are not included in the definition of green power, even if such technologies have been improved in terms of their efficiency and emissions. Examples of these technologies would include:

- light fuel oil, heavy fuel oil and diesel – generation of electricity from petroleum products;
- coal – thermal generation of electricity from coal;
- municipal solid waste – thermal generation of electricity from municipal solid waste;
- gas – conventional generation of electricity from natural gas; and
- nuclear – generation of electricity from nuclear sources.

The Yukon Green Power Initiative is a tool that will be used to achieve green power goals and objectives. The primary goal is "to increase the production and sale of *small-scale renewable energy* meeting the electrical service requirements of Yukon communities and industry, while reducing greenhouse gas emissions." Effective planning and program design requires that, *within a Yukon context,* an operational definition of what constitutes 'small scale renewable energy', or 'green power' must be established.

# *Challenges and Opportunities for Green Power*
# *A Yukon Perspective*

***Background Paper #2***

This paper highlights some of the characteristics of the Yukon energy situation having implications for green power development in the Territory. In some cases local circumstances may provide unique opportunities; in others, they may present significant challenges to implementation. For ease of reference and to provide context, a map displaying the Yukon energy supply system is attached.

**Characterization of the Yukon Energy Supply System**

The characteristics of the Yukon energy system make the introduction and expansion of green power more challenging in some respects, while at the same time there are unique opportunities for green power.

- *Instability of demand* – Demand for power in the Yukon can fluctuate widely from year to year, particularly on the Whitehorse-Aishihik-Faro (WAF) grid. For example, load fluctuations in the order of 40% can occur, based on whether the Faro mine is in operation, or not.

  It is risky for the utility or an independent power producer to add capacity to the grid system in the absence of secure long-term load requirements. Additional power could be surplus to needs while the cost of the infrastructure still has to be paid for. At present, with the Faro mine not operating, there is a significant surplus of capacity on the system. This represents a challenge to green power implementation in the short-term.

- *Seasonal requirements* – The most power is used in the winter months and at certain times of the day and the week. Reliable and flexible power supplies must satisfy these requirements.

  Existing hydro infrastructure creates a significant summer power surplus on the WAF grid when demand for power is generally at its lowest, even under high annual load conditions. The green power challenge is to develop supply options that match the seasonal demand for power.

- *Resource fluctuations* – About 65% of the WAF grid's capacity comes from hydro-electric generation. With fluctuating levels of precipitation and run-off, and limited ability to store water from summer to winter or year-over-year, the supply of power from hydro sources varies annually. Any shortfall that cannot be met with hydro is currently met primarily through diesel generation.

  In an oversupply situation, there will be less incentive to install additional capacity except where other important objectives can be met, such as increased power reliability and quality. To some degree, this problem can be mitigated if there is an opportunity to store water for future periods, such as occurs with the Aishihik Lake generation plant now. An under-supply situation creates an opportunity for green power because the reliance on diesel increases. It is difficult to cost-effectively replace diesel-generated electricity for short-term periods of fluctuations due to its low capital costs. Long term fluctuations, such as drought years are impossible to predict, making it difficult to coordinate green power initiatives with dry years.

- *Remote communities* – While linked by highways, there are many communities in the Yukon that do not have access to the main WAF electrical grid. They are all served by diesel generation.

  This provides opportunities for green power technologies to replace diesel. At the same time this isolation from the territory's' electrical grid means that excess green power cannot be sold for use elsewhere. It can also be more difficult to service and maintain facilities in these locations in some circumstances, such as Old Crow.

- *Isolated Grid* – In addition to isolated community energy systems, the main Yukon electrical grid is not connected to neighboring jurisdictions. This means that buying and selling power on the North American markets to accommodate fluctuations in power supply and demand cannot occur.

  This creates an opportunity for green power because in an isolated system, local solutions to problems are not compromised by obligations and/or supply options associated with being part of a larger system. In addition, because of its isolation and other factors, the costs of producing power in the Yukon is somewhat higher, creating some opportunities for green power. However, being part of an isolated system also presents a barrier in the sense that it precludes green power producers from selling excess power to distant markets.

- *Regulated regime* – Two regulated utilities dominate the production and distribution of power in the Yukon. Costs incurred by these utilities to be recovered through electrical rates are subject to approval by the Yukon Utilities Board primarily through general rate applications.

In a regulated regime, the regulator could encourage or support utility initiative to address certain facets of green power. If the regulator supports green power objectives, based on known costs and benefits, this would be beneficial to green power implementation. Without regulatory support the utilities will be constrained.

- *Technical and public safety standards* – Electrical utilities are required to meet industry standards that ensure public safety, system reliability and power quality.

  These standards must be addressed as an integral part of designing and installing green power including connections between independent power projects and utility systems.

- *Relatively small system* – The Yukon population, business base, and energy systems are small in relation to many other jurisdictions. This means energy supply and demand are relatively small scale, and that the diversity and extent of growth are limited.

  The implication for green power is that there is not a large customer base from which a demand for green power purchasers may come. There are opportunities for a variety of programs and projects, but not a broad business base and few economies of scale.

- *Available resources* – The Yukon has a solid renewable resource base including solar, wind, rivers and streams. There is considerable bio-mass resource in the forest. If those resources are managed sustainably, then wood waste products may become available for the production of green power.

  There are many opportunities to harness green energy resources and to generate green power in the Yukon, some of which are already being exploited or explored. The availability and even the location of resources and the technical aspects of harnessing the power do not need to be major hurdles.

- *Northern conditions* – The seasonal, geographic and climatic conditions of the north have a bearing on energy options. The Yukon is characterized by long distances, long summer days, long winter nights, cold winter temperatures and freezing patterns, and winter winds. In terms of energy demand and potential green energy supply the following characteristics are relevant:
  - ← Winter load = Summer load x 2
  - ← Average stream flows in Winter = $\leq$ 1/20 peak Summer flows
  - ← Solar in Winter = $\leq$ 1/5 Summer
  - ← Wind in Winter = $\geq$ Summer x 2 (at higher altitudes)

  These characteristics have a bearing on green energy supply options.

These characteristics will influence green power developments in the Yukon. Solar, wind and micro-hydro electricity generation need to be designed and adapted to operate well in this environment and operations will differ at different times of year.

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- *Green power projects* – A small number of green power projects are already underway in the Yukon. Despite the low number, they are significant because of the experience being gained from them. Studies and inventories have also been done to identify other potential sites for harnessing green energy resources, including wind, bio-mass and micro-hydro.

  The future development of green power in the Yukon will build on the experience gained from projects conducted to date. This includes testing and adaptation of wind technology, solar applications for home energy, and independent power produced from micro-hydro.

- *Energy policies and processes* – There have been a number of Yukon-based energy-related public and stakeholder consultation processes in 1980's and 1990's spearheaded most recently by the Yukon government Energy Commission.

  These initiatives have raised public awareness about energy supply options for the Yukon and have identified significant public support for green power. The Yukon government response to the Final Report of the Energy Commission provides a made-in-Yukon policy framework, supported by various major initiatives, to advance green power goals.

**Critical Factors Affecting Green Power Implementation**

This section focuses on specific issues for green power installation and use in the Yukon including cost/financial, regulatory, technological and educational. It is important to recognize that there are different points of view on many of these issues, and the following information is not intended to represent a consensus of stakeholder perspectives. Rather it provides some perspective on the debate and factors that must be taken into account.

**Cost/Financial Issues**

Since electricity has been seen as an essential good in a modern society, financial measures have been designed to ensure lowest possible price to consumers. These measures are sometimes perceived as creating barriers to green power installation.

- Cost advantages/tax incentives - Conventional energy facilities may not address the full costs of their environmental impacts and across Canada they have the benefit of decades of historical government subsidies. Examples of special support would include: utility income tax and license fee advantages, utility write-down and

financing advantages, rights of land expropriation for hydro-electricity projects and petroleum/coal industry subsidies and tax incentives.

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The full cost of building the existing hydro-electric infrastructure in Yukon was written down at the time it was sold to Yukon Energy Corporation. In general, such support makes conventional energy less expensive to today's energy consumer. While governments are moving toward encouraging green power through tax incentives and other financial instruments, this is a relatively new development on the Canadian energy front. It remains problematic for non-subsidized green power producers to effectively compete with conventional energy facilities and utilities.

- Stranded costs – Replacement of existing sources of diesel supply with green energy would, to some degree, 'strand' assets such as diesel generators, in the sense that these assets would no longer be generating the same level of revenues to off-set production and/or capital costs. When such stranded assets occur, there is the basic question of 'who pays'. However, at present capital costs of diesel are relatively low and given that such generators would be necessary to 'back-up' and/or augment green power supply sources, the actual losses may be incremental only and not affect the overall viability of the green power alternatives.

- Establishing green power production targets – Without a stable market for the sale of green power (market refers to both electrical consumers and from independent power producers to utilities), it can be difficult to justify the installation of new green power capacity. Setting a production target could address this issue. However, a number of factors complicate this approach, including; instability of electrical demand, load factors, seasonal variations in electrical usage, energy efficiency programs and issues related to base load versus incremental load production.

- Installation costs - The up-front costs can be higher for green power than for conventional energy sources. Additional costs of green power may also include a mechanism(s) to manage a dual or hybrid supply system (i.e. part-time green and diesel) in 'non-grid' communities (where diesel is currently the only source of supply), as well as normal costs associated with integrating new capacity into the WAF grid/system.

- Green power is still 'emerging' technology – The low market uptake of green power technologies to date has meant that few manufacturing facilities have been developed to produce them, and few players compete to supply them to the market. This in turn puts green power technologies at a financial disadvantage compared to mature technologies that have multiple suppliers, and have achieved extensive economies of scale in their application and economies of manufacture in their production.

- Investment financing – Non-utility proponents (i.e. usually smaller) may have difficulty obtaining financing for new green power projects.

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- Nature of market demand for electricity – Electricity supply fluctuates significantly in the Yukon, making flexible and non-capital intensive options more appealing. Although many green power options are portable and are very flexible with respect to their modularity and small scale, they are generally capital intensive, requiring a significant up-front investment.

Regulatory Issues

- Utility regulation – The higher up-front capital costs of green power alternatives could result in requirements for rate increases, something that is inconsistent with rate stabilization objectives. These alternatives generally require longer-term vision and longer-term paybacks on their capital investments.

- Allocation of costs – In most areas of the Yukon non-industrial and non-government ratepayers do not pay the full cost of producing electricity. From an independent power producer perspective this can be a challenge when the producer is attempting to sell directly to the customer. This occurs because the independent power producer must build a business case based on the real cost of producing power and set prices accordingly.

- The 'avoided cost' of diesel generation test – The policy requires independent power producers on the grid to beat the cost of diesel generated power as determined by the utility. This is problematic because it asks the utility to determine with certainty that any power it purchases from an independent power producer costs less than diesel-generated electricity. It has been argued that utilities only consider short-term direct costs of diesel generation creating a practical barrier for new suppliers.

- Requirement for new regulations – New regulations may be required to ensure safety and equity for net-billing and independent power producer projects connected into existing power grids.

- Sizing of electrical utility production facilities – Utility companies have a legal obligation to supply power. They are required to forecast future power requirements and construct generating facilities capable of meeting present and future electrical requirements with additional back-up capacity to ensure system reliability and public safety. The additional capacity is often large enough to cover growth in demand for several years.

- As electrical growth uses up this generation capacity, the utility undertakes the planning necessary to augment the system by adding new capacity as required. This process may create opportunities for green power installation.

- Environmental review and permitting processes and lengthy project lead-times – These are common for all development projects, green or conventional. However, green power projects are often smaller in scale and may not be able to afford the extensive environmental studies and impact analysis required by the regulators.

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In the Yukon even the smallest micro-hydro projects require water licensing, land use, building, electrical and other permits. This can be overwhelming for residential and/or small project proponents.

**Technological Issues**

- Technology is new and not readily available in the territory – Many green power technologies are still at an early developmental stage and have not been tested in a northern climate. In addition there are few sources of local information and essential equipment is not normally available within the region.

- Adapting for northern use – Some technological adjustments and improvements may be required, particularly as they involve applying technologies in northern conditions where climate and latitude are important factors. For example, the wind program had to address rime-icing and cold temperature problems.

- Achieving reliability a challenge – Some renewable resources, like wind and solar radiation, are intermittent, making them less consistent than conventional sources such as diesel. Consumers generally want reliable power. This situation could, in part (i.e. on the WAF grid) be addressed by using green power to supplement use of renewable hydro-electricity from the Aishihik facility. Water not used for generation at Aishihik in one year can be stored for future use. However, there are limitations on this approach. Once the reservoir is at full supply, no further advantage can be gained from it, for long-term storage. In off-grid communities, hybrid systems involving diesel generation would probably be necessary.

**Education Issues**

- Limited knowledge base in Yukon – There is believed to be a lack of consumer, industry and utility awareness and 'know-how' about green power options and technologies that are available or under development. Also, potential independent power producers lack knowledge of programs and measures in other jurisdictions.

- Awareness of environmental impacts – There is believed to be a lack of awareness among consumers on the environmental impacts of conventional electricity supplies.

Consumers need to understand that every supply project is to some extent site specific, with different benefits and impacts.

- Consumer understanding – There is a perceived need to educate consumers regarding the difference between 'green power' facilities and existing 'renewable hydroelectric' power facilities, some of which fit the definition of 'renewable energy', but may not be 'green' because of land use or ecosystem impacts.

- Consumer perceptions – Possible public perception of 'higher cost', availability, safety and quality issues respecting green power alternatives would need to be addressed with consumers.

Instruments in this category include information, education, and training programs for the public, business, utilities and independent power producers, and energy service providers (such as equipment installers and repair specialists). Education and capacity building measures are intended to:

- increase awareness, interest, and understanding of green power among energy consumers and suppliers, and provide the motivation to take action;
- promote green power and its societal benefits;
- create demand for green power; and
- foster the development of technical capabilities to deliver green power services.

There are two main audiences for information and education on green power sources and applications: customers and suppliers (producers and distributors). Awareness programs for customers focus on what green power is and the societal benefits of supporting it, whereas programs for suppliers and other service providers focus on training of practitioners.

***'Education and awareness'*** in this context refers to information programs, educational campaigns, and related initiatives geared towards the general public and electricity consumers. Consumers refer to those in the residential, commercial (including government and institutions) and industrial sectors, and programs and information will differ among these groups. Basic programs for individuals might include brochures on the different kinds of green power, discussions of environmental impacts (including climate change) of different energy sources, and opportunities for individual deployment of green power. Programs for commercial and industrial customers would identify the types of available technologies, their costs and payback periods, regulatory benefits with respect to emissions reduction benefits of green power, opportunities to enhance their corporate image, new market opportunities, and other advantages. Some examples of existing programs follow.

The ***Canadian Renewable Energy Guide***, written by the Solar Energy Society of Canada Inc. (SESCI) in collaboration with other organizations, is a one-stop source for much information on renewable energy in Canada. The guide shows Canadians how to use renewable energy technologies such as green power in their homes, cottages, remote

sites, transportation, industry, agriculture, and more. The guide identifies specific actions to conserve energy and replace conventional sources with renewables, and case studies are provided. It features sections on:

- passive, active and photovoltaic (PV) solar energy;
- geothermal and earth energy;
- micro-hydro, wind, and biomass;
- co-generation of electricity and heat;
- electric utilities' renewable energy initiatives;
- rural, remote and northern applications; and
- climate change and greenhouse gas management (2nd edition).

The guide contains a directory of Canadian renewable energy companies, products, applications and services. A second edition is scheduled to be published and distributed early in the summer of 1999. SESCI also has a series of renewable energy pamphlets and educational programs for students of all levels.

The ***Center for Renewable Energy and Sustainable Technology*** (CREST) develops and disseminates multimedia educational materials and exhibits on renewable energy. Materials include CD ROMs, as part of a series on green homes, green developments, the sun's joules, community PV, SolarSizer, and green buildings (the latter two are software tools for professionals).

The organization also sponsors e-mail discussion groups on green power and other topics. Their Global Energy Marketplace, co-sponsored by the U.S. Environmental Protection Agency, is a searchable database of over 2,500 renewable energy and energy efficiency annotated web-links. One part of the database, called ReInState, features case studies, products and services, utility information and policies and programs for each state in the U.S. The CREST website, called Solstice, provides information and links to relevant organizations and documents. The organization has offices in Washington, D.C. and Oakland, California.

***'Supplier capacity building'*** relates to the capacity of those providing electricity and related green power services to successfully deploy green power installations and any follow-up activities. "Capacity" refers to technical and business know-how as well as prompt service, a full range of integrated services, and ability to keep up with changing technologies. Suppliers could include utility staff; independent power producer (IPP) operators; suppliers of energy products and services; and construction, installation and repair technicians. All these types of people require information, education, training, on-the-job experience, and upgrades to their knowledge and training as time goes on.

Capacity building activities include training and supporting technologies such as computer software. Some examples of existing programs follow.

***Solar Energy International*** (SEI) of Colorado focuses on renewable energy education and sustainable development, offering comprehensive, practical training programs. Workshops from their Renewable Energy Education Program are one to two weeks in length and include, among other things:

- photovoltaic design and installation;
- advanced photovoltaic;
- micro-hydro power;
- wind power;
- solar home design; and
- solar businesses.

These courses include system sizing and site analysis, hardware specifications, component selection, typical applications, case studies, field installation, and tours, as well as comparing life cycle costs of alternative designs. SEI also offers on-line courses, using expert input, design handbooks, software, CD ROMs and Internet sites. To date, these have all been photovoltaic courses.

A number of organizations in Canada offer workshops and courses for small scale, renewable energy do-it-yourselfers and practitioners. Key ones are noted below, with additional references provided in Background Paper #7. These tend to be two-day intensive courses, often offered in conjunction with a conference on renewable energy.

- The *Canadian Solar Industries Association* (CanSIA) offers workshops on various solar energy topics such as photovoltaics, solar walls, solar hot water heating, and solar architecture. They are generally offered in conjunction with a conference on related topics.
- The *Canadian Wind Energy Association* (CanWEA), in collaboration with the American Wind Energy Association, has offered a wind-diesel workshop annually for the last 12 years. Proceedings are available from the association. (This course is utility scale focused.)
- *Energy Alternatives*, a BC firm specializing in small-scale renewable energy, offers do-it-yourself micro-hydro courses in collaboration with Solar Energy International and various BC community colleges. Most courses are intensive two-day sessions, including a manual, presentations, and displays.

**Yukon Experience**

This section illustrates activities relating to education and capacity building, currently or previously undertaken in the Yukon.

- The Yukon Government has commissioned and published several series of reports on alternative energy, describing the alternatives, the opportunities and potential applications, technical features, and what applications have occurred to date.
- The Yukon Energy Corporation and the Yukon Electrical Company Ltd. along with other partners introduced the PowerSmart program in the early 1990's, although it was subsequently discontinued.
- The Yukon Conservation Society and others have been promoting sustainable approaches to energy management and have provided materials to the public on energy conservation and related matters.
- Practitioners have pursued educational opportunities out of the territory and have learned on-site during projects or test sites; external specialists have been brought in on specific occasions.
- The 1997 Energy Fair and the 1998 Energy Awareness Program provided public workshops and other educational opportunities.

New alternative energy supply businesses have been established.

Further educational and capacity building measures are applicable to the Yukon, given the early stage of green power development. There is a large potential for disseminating information and developing local capacity. Other jurisdictions have laid much of the groundwork in developing resource materials, so there is no need to reinvent these. However, there will be a need to tailor the materials in some respects to suit the Yukon situation. For example, the economic comparisons of supply options are different for each jurisdiction, as are the most suitable resource types to harness, given local technical and geographic performance factors.

Research and development are other important factors in developing a green power initiative and in assisting green power to find its way in the marketplace. Instruments in this category usually include funding programs and multi-faceted initiatives to identify green power resources and opportunities, enable research and testing, pilot and demonstrate green energy technologies, and bring those technologies to full commercial participation in the marketplace. Measures within this category are geared towards:

- assessing green power resources;
- providing capital and operating funds for research and infrastructure with uncertain paybacks;
- improving the technical performance of green energy technologies;
- reducing the costs of manufacturing and producing green power;
- adapting and demonstrating the technologies in particular locations; and
- deploying technologies within the marketplace.

Resource assessment involves identifying physical opportunities to deploy green power technologies. Research and development constitutes the initial stages of designing new technologies and requires time, funding and technical capability. Research programs in themselves do not have a short-term payback, so they tend to be funded by governments, large corporations (including utilities), and institutions such as universities and hospitals. Some examples of existing programs follow.

A number of ***Natural Resources Canada*** (NRCan) programs that focus on or link to research development and demonstration are described below. These programs have other components such as education and demonstration, but are better described here as a core set.

The ***CANMET*** (Canadian Centre for Mineral and Energy Technology) **Energy Diversification Research Lab (EDRL)** is a centre for research and development in alternative energy technologies. The lab carries out applied research and development activities, generally in collaboration with industry and other partners, and conducts analyses to match end-users with appropriate technologies. Within the EDRL, energy efficiency, and renewable energy and hybrid systems are the main areas of focus.

Within the latter program group, there are sections focusing on:

- renewable energy and hybrid systems;
- photovoltaics (PV);
- renewable energy for remote communities; and
- refrigeration and heat pumping technologies.

The ***"PV for the North"*** program was a five year, $1 million program that ended in 1998. It was an agreement between the EDRL and the Nunavut and Aurora Research Institutes. The research and development activities were supported by PERD funding (Panel on Energy R&D). Program activities included:

- identifying and evaluating PV markets in the NWT;
- conducting targeted technical and economic studies;
- demonstrating and analyzing the performance of PV systems operating in arctic conditions;
- developing technologies better adapted to cold climates; and
- transferring information and educating potential users and decision-makers.

Two demonstration projects were established: one 3.2 kW PV array at Nunavut Arctic College in Iqaluit, and a PV-wind-diesel hybrid system at the Aurora Research Institute in Inuvik.

The EDRL ***Renewable Energy in Remote Communities*** **(RERC)** program is designed to help local practitioners determine appropriate renewable energy technologies for their applications. The program's aims include:

- increasing knowledge and awareness among builders, developers, managers and aboriginal leaders of renewable energy technologies (RETs);
- funding technology transfer initiatives; and
- providing technical training and support.

A renewable energy and energy efficiency awareness course is being developed with Indian and Northern Affairs Canada, with delivery to begin in 1999. At that time, NRCan will be seeking partners to deliver the course, particularly in aboriginal and remote communities. NRCan is currently identifying potential renewable energy projects in remote communities across Canada, doing studies that may lead to implementation. A main feature of the program is the RETScreen software and the accompanying manual. This software uses Excel spreadsheets to help with technology assessment as well as pre-feasibility and feasibility studies. It covers wind, small hydro, photovoltaics, the Solar

Wall, and biomass heating. New software scheduled for release in 1999 will support solar hot water, ground-source heat pumps and passive solar.

The ***Renewable Energy Technology Program*** **(RETP)** aims to accelerate the penetration of renewable energy in Canada and to help exploit international opportunities. Technologies covered include bioenergy, small hydro (less than 20 MW), active solar, photovoltaics and wind. The annual funding of $5 million tends to be allocated to industry, predominantly equipment manufacturers, to improve the performance or decrease the costs of the equipment. The program would also help finance modifications that are needed to adapt to other countries in order to sell abroad. Two proponents currently receiving funds are Dependable Turbines of BC. for small hydro, and Conservall for solar walls in NWT.

The ***Quebec Energy Technology Development Assistance Program*** (not applicable to Yukon – for example purposes only) provides financial support for research and development in all areas of energy technology, with priority given to hydrogen, biomass and wind. Program goals are to:

- contribute to energy resource diversification;
- support new technologies whose research costs cannot be covered entirely through private investment; and
- develop technologies to reduce pollution caused by energy uses.

The program focuses on research and development, but also includes demonstrations and the initial commercialization of new technologies. It is a co-financing program in which the government provides varying percentage contributions depending on the specific application. The annual budget is between $1.5 and $2.0 million. A proposal is being prepared for wind and PV initiatives at a copper mine (Ragland) in northern Quebec. A PV system was installed in a First Nations community on an island in northern Quebec (near Val d'Or) by Solinaire of the Enersat Group; this project included prepaid energy and cards that track energy use against the prepayment.

The ***Southwest Alberta Renewable Energy Initiative*** or SWAREI (not applicable to Yukon – for example purposes only) described in the next section commissioned a detailed wind resource assessment for southwestern Alberta. The assessment included:

- an effort to synthesize technical information about wind energy resources;
- analysis of existing weather data for wind speed information;
- installation of eight new wind monitoring stations at strategic locations in the region;
- monitoring of those sites and analysis of wind speed data; and
- production of a detailed report on the wind energy potential in that region.

Demonstrations and pilots are very important stages in technology development. They build on initial research and development to make the products and technologies practical for commercialization, but it is often difficult to obtain funding for these initiatives. Some examples of programs are described below.

In 1988, Alberta passed its ***Small Power Research and Development Act***, which was essentially Canada's first set-aside for renewables in the electricity sector. This provided for an incentive purchase price of 5.2 ¢/kWh for small renewable energy projects (including wind, biomass and small hydro), through 10-20 year contracts with electric utilities. The associated ***Small Power Research and Development Program*** has approved 18 renewable energy projects to date with a total capacity of 108 MW and a total contract value of over $30 million. Of the 18 projects, six were small hydro, three were biomass/waste energy and nine were wind energy.

The ***South West Alberta Renewable Energy Initiative (SWAREI)*** ran alongside the above programs in the early years. It had a budget of $3 million from the Heritage Trust Fund, and ended two years ago. One of the first projects funded was a wind resource survey of southwestern Alberta, to determine the nature and extent of the wind resource and the most promising locations. The SWAREI program had a number of wind test sites and an information centre in Pincher Creek.

The ***Alberta Renewable Energy Test Site*** **(ARETS)** near Pincher Creek focuses on wind and solar applications for agriculture. It received some funding from SWAREI during the first three years of that program, as well as funding from Natural Resources Canada, Alberta Environmental Protection, and Alberta Agriculture, Food, and Rural Development. It is now fully funded through contracted services provided to industry.

CANMET, in partnership with Nunavut Arctic College and the NWT Power Corp., established a demonstration solar photovoltaic array in Iqaluit, NWT in 1995. The 3.2 kW PV array is mounted on the facade of the college and is connected to the local diesel grid. The goal of the project is to generate hard data on the performance of PV arrays in the arctic, with the hope that such information can help northern planners justify the installation of such systems on economic and technical grounds.

Another demonstration project in Ellesmere Island National Park involved the installation of a PV-wind-diesel hybrid system. Parks Canada based on a CANMET study showing the feasibility of PV for the site installed this system. The system includes a 576-watt PV array, a 600-watt wind generator, and a battery bank in addition to a diesel generator. Together, the solar and wind technologies cover most of the camp's electrical load, dropping the average diesel generator operating time from 18 hours per day prior to installation to 2.2 hours.

**Commercialization and Market Transformation**

Commercialization is a vital stage between the research and development phase and the full market penetration of a product or technology. It involves technically mature products that are not produced on a large scale and of which consumers are often not aware. Barriers at this stage can include high costs due to low economies of scale and manufacture, undeveloped industrial infrastructure, high marketing budgets, and low customer recognition of the product. An example of a commercialization program is the US Million Solar Roofs Initiative.

The U.S. ***Million Solar Roofs Initiative*** will facilitate the installation of solar systems on one million rooftops across the United States by 2010. The Department of Energy leads this initiative and will work with partners in the building industry, local governments, state agencies, the solar industry, electric service providers, and non-governmental organizations to remove market barriers and strengthen grassroots demand for solar technologies. The initiative will deliver federal government resources to support local leaders in their efforts to develop a strong community commitment to the sustained deployment of solar energy technologies. To help speed the development and use of solar technologies, both state and federal governments have established regulatory and financial incentives.

This is a solar energy market transformation initiative with a strong emphasis on technology commercialization. Technologies included in the initiative are photovoltaic solar, solar water heating, and solar space heating systems that provide energy to homes or buildings. Program goals are to:

- install one million solar energy systems on U.S. rooftops by 2010;
- slow greenhouse gas emissions;
- expand national energy options;
- create high-technology jobs;
- build on existing momentum and marshal existing government resources;
- keep U.S. companies competitive; and
- rely on market forces and consumer choice.

Program benchmarks call for 51,000 systems to be installed by the year 2000, 376,000 by 2005, and one million by 2010, with a total installed capacity of 3,025 MW in 2010.

**Yukon Experience**

This section illustrates activities related to research and development, currently or previously undertaken in the Yukon.

- Yukon Energy has been operating a test wind turbine at Haeckel Hill since 1993. The facility had its most productive year in 1998. Yukon Energy has also monitored the wind regime in areas such as Destruction Bay, Dawson City and Haines Junction; it is currently monitoring in Whitehorse and Old Crow.
- The Boreal Alternate Energy Centre has been a major proponent of wind power in the Yukon, collaborating on and initiating much of the wind testing work. Boreal is also working on a Yukon College project; a wind and photovoltaic demonstration project (at Yukon College, adjacent to the Northern Research Institute).
- Yukon Energy has identified a number of wind and hydro sites as candidates for the NRCan studies on potential renewable energy projects across Canada. Various proponents have been discussing possible co-generation projects and community energy management opportunities with NRCan.
- Yukon Energy and others have identified hydro potential in locations throughout the Yukon.
- Micro-hydro facilities have been developed at Rancheria (149 kW), Mile 7 Carcross Road (2 - 2 kW facilities), Stewart-Mayo highway (1 kW), Mayo Lake (35 kW) and Fraser (250 kW). There are also a number of rural wind/diesel installations and a photovoltaic facility, all of which are self-generating, off-grid applications.

Only certain aspects of research, development, demonstration and commercialization are applicable to the Yukon. Systematic resource assessment to identify and fill key information gaps is important in identifying the most appropriate potential applications for green power. Applied technology research and development, such as in a laboratory setting is most likely better left to jurisdictions with substantially greater facilities and resources, given limited funds available in the Yukon to support the program.

However, the Yukon can build on work already done and take the next steps needed for implementation in the territory. This approach has worked well with wind – that is, monitoring the resource, applying an existing technology, learning about how it has been applied in other northern jurisdictions, and testing and modifying it for Yukon application. This same approach can be applied in more depth to micro-hydro, solar, and biomass, as well as wind. The Yukon can benefit from more demonstrations and pilots in the residential and commercial sectors. A key strategy is to leverage research and development support funding from other sources, such as the various NRCan programs and the private sector.

Green power installation refers to the actual development and supply of green power generation facilities and related technologies by electricity suppliers such as utilities and independent power producers. In some cases, this may include other green energy technologies such as district energy and solar hot water heating, particularly if these reduce electrical loads. Green power installation instruments involve commitments and investments on the part of utilities, as well as partnerships and other financial mechanisms to encourage such investment. Such instruments are designed to:

- overcome initial cost barriers to installing green power capacity;
- gain experience with green power technologies;
- make green power more prevalent and encourage further expansion;
- achieve environmental benefits, notably reduced greenhouse gas emissions;
- provide economic diversification and employment;
- improve the cost-effectiveness and competitiveness of green power options; and
- create a more robust and self-sufficient green power industry.

The most straightforward way to increase green power investment is to 'just do it.' Utilities may invest in green power on their own or with partners such as various levels of government or communities, electricity consumers or private sector interests. Some examples follow.

***NWT Power Corporation*** (NWTPC) has undertaken a number of green energy projects in the Northwest Territories. These include four wind turbines: one 50 kW turbine recently installed in Sacks Harbour, two 80 kW units installed in Coppermine two years ago, and an 80 kW unit installed in Cambridge Bay in 1994/95. The latter is owned by Dutch Industries from Regina, which sells the power to NWTPC. This turbine produces about 170,000 kWh per year, displacing some 60,000 litres of diesel (equivalent to a greenhouse gas offset of about 165 tonnes per year).

***The Dogrib Power Corporation*** (DPC), owned by the Dogrib Nation, installed a 4.3 MW small hydro plant in 1993, making it the first independent power producer in the NWT. The Dogrib Power Corporation negotiated a 65-year power sales agreement with the NWTPC in which DPC is the wholesaler and NWTPC is the retailer on the 150-mile grid. The goal was to reduce production of electricity from diesel, and the DPC successfully demonstrated that hydro is a lower cost alternative over the long term. The entire $27

million project was financed through the private sector outside of commercial lending institutions. There are plans for a second phase, which would include two plants of roughly the same capacity, totaling 25MW, at a project cost of $120 million.

A $1 million private investment has been made in district energy in ***Fort MacPherson***, using heat recovery from the NWTPC diesel generator. Other communities, including Rankin Inlet and Pangnurtung, are also considering this option. Residual heat from NWTPC plants is being recovered in ten communities and sold by NWTPC to individual commercial customers, including an auto shop.

**Purcell Lodge** is a year-round tourist resort in the Rocky Mountains near Golden, BC. A 12-kW run-of-river micro-hydroelectricity generation system was installed at the Lodge in 1992 by Energy Alternatives of Kamloops to offset the use of a 12-kW diesel generator. There are no batteries with the system. The system meets all the electrical needs of the Lodge, virtually eliminating the use of the diesel generator and about 15 percent of the heating load.

The micro-hydro system has demonstrated several financial, environmental and social benefits for Purcell Lodge and the area. The simple financial payback is under three years. Annual diesel energy savings are equivalent to about 15,200 litres, and annual propane savings are about 1,400 litres per year. The greenhouse gas emission reductions produced as a result of not burning these fuels are about 43.6 tonnes per year. In addition, the elimination of noise and local emissions from the generator is considered to be a large benefit for tourism.

The ***Lillooet, BC Recreation Centre*** operates its indoor pool three months of the year – May, June, and July – and has an ongoing challenge to control its heating costs. The pool building was originally constructed with a low-slope, south facing roof in the hope that solar heating would one day be installed. Although the Centre did not have the capital funds to purchase a solar heating system outright, Taylor Munro Energy Systems and Yalakom Appropriate Technology provided financing and equipment to install a solar energy heating system for the pool in May 1998. The system works with the propane boiler to keep the pool at operating temperatures.

Through this innovative financing method, similar to the approach taken by Energy Service Companies for energy efficiency upgrades, the Recreation Centre did not incur capital costs for the system. Instead, the system is monitored for performance and the Centre pays only for the energy used, at a rate cheaper than what it pays for propane. There are immediate savings for the Centre, as it cuts its propane use for pool heating by over 90 percent. Taylor Munro Energy Systems has maintained ownership of the greenhouse gas emission reduction benefits of the system.

***Community Energy System in Oujé-Bougoumou*** - In 1992, the Cree First Nation community of Oujé-Bougoumou became the first on the continent to implement a village-wide district heating system based on biomass resources. This was possible as the system was designed into a new community. The system does not provide substantial financial savings over the use of electricity for heating, but the James Bay community of 650 residents decided to pursue the project because of the environmental, community, economic development, and self-sufficiency benefits it offered.

The project includes a central plant with a 1.4 MW waste sawdust boiler, a peaking oil boiler of 1.4 MW, and a 1 MW oil backup system. By mid-1997, 135 homes were connected to the system, each consuming about 10kW for space and water heating, and 450kW were used for public buildings. The buildings are connected to the central boiler through a network of piping. Each building is equipped with energy meters to measure monthly consumption, and customers are billed in a similar fashion to electric utility customers. All homes in Oujé-Bougoumou exceed the R-2000 energy efficiency standard. In 1995, biomass provided 85 percent of the energy used to fuel the system, yet accounted for only 15 percent of the fuel costs. The capital cost of the system was $2.5 million, and the annual operating and maintenance costs were $238,000. The district heating project was financed almost exclusively from local development funds with small contributions from Natural Resources Canada and Hydro-Québec.

**Economic Instruments and Financial Mechanisms**

'Economic instruments' can denote a wide variety of market-based mechanisms to induce business activity and influence decision-making; examples are tax incentives, cash rebates, environmental product surcharges and emissions trading. In the context of encouraging investment in green power installation, these instruments could include:

- tax incentives to encourage further capital investment;
- utility-IPP purchase price agreements to guarantee specific arrangements;
- emission charges or carbon taxes applied to utilities;
- emission trading programs to encourage generation of emissions reduction credits through green power developments;
- grant and low-interest loans for proponents purchase and install green power systems; and
- green power funds applied to the above or other initiatives.

Examples of tax measures, pilot trading mechanisms and green funds are described below.

***Federal Tax Measures for Renewable Energy*** - There are two main federal income tax measures that encourage investment in renewable technologies, or help reduce the gap in financial treatment between renewable energy and conventional energy investments such as oil and gas exploration and extraction.

The first one is ***Capital Cost Allowance Class 43.1***, which allows companies to deduct depreciation expenses from certain assets against their revenues at a rate of 30 percent per year. This rate is faster than comparable industrial products and is in line with accelerated rates for manufacturing and processing equipment and oil and gas development costs. Within specific definitions of eligibility, this tax measure applies to small hydro, wind, photovoltaics, geothermal, efficient co-generation, industrial active solar and waste heat recovery (for industrial processes), and landfill or digester gas. The 1996 and 1997 federal budgets contained some slight modifications to this measure, making it more broadly applicable.

The second federal income tax measure of note is ***the Canadian Renewable and Conservation Expense***. This measure is intended to provide tax treatment for renewable energy similar to those afforded oil and gas exploration ventures. It permits a 100 percent deduction of specified pre-production intangible (non-capital asset) costs, such as pre-feasibility studies, site approval, and market research. Qualifying expenditures are specified on a list for each type of technology (e.g., wind) that was prepared with stakeholder input. The deduction may be carried forward into any future year, when there is more likely to be income against which to deduct and thereby reduce taxes otherwise payable. The deductions may also be "flowed through" to a certain category of shareholders, so they instead can deduct the expenditures as a degree of compensation for their investment in the technology. The 1997 budget added test wind turbines to the list of eligible items, and the criteria are less stringent for remote grids and off-grid situations.

***Greenhouse Gas Emission Reductions – Credit for Early Action*** - Canada is now updating its National Action Program on Climate Change in response to commitments negotiated under the Kyoto Protocol in December 1997. Emissions trading systems, such as those operating in the U.S., are being examined for potential application to greenhouse gases in Canada. Pilot projects are being undertaken, including the ***Greenhouse Emissions Reduction Trading (GERT) Program***. Under this voluntary pilot program, initiated in BC, but now including Alberta, Saskatchewan, Manitoba, Quebec, Nova Scotia, and two federal government departments, participants may record greenhouse gas emissions reductions and trades. There is no guarantee that these will be recognized in an official program in the future, but general assurances are being made to address this issue.

A companion measure announced by federal and provincial ministers of energy and the environment is a commitment to establish a ***'Credit for Early Action'*** program in the

spring of 1999. Under this program, participants will be able to create greenhouse gas emission reduction credits that they can use and obtain value for at some future date. Stakeholders are conducting the initial discussion about system design through the national climate change 'Issue Table' process. It appears unlikely that a fully operational system will be launched by spring 1999, although it is probable that some initial actions that facilitate the establishment of a system will be taken. Such a program will significantly increase the incentives for private sector purchases of greenhouse gas emission reduction credits, in effect creating a revenue stream from greenhouse gas emitters to green power developers.

***Alaska Power Project Revolving Loan Fund*** - The Alaska Power Project Revolving Loan Fund is a loan program created by Alaska Statute and administered by the Division of Energy under the Department of Community and Regional Affairs. The fund provides loans to local utilities, local governments, and independent power producers to develop or upgrade electrical power facilities. Eligible types are active solar water or space heating, solar thermal electricity, photovoltaics, wind, alternative fuels, and waste energy. The amount of the incentive varies, with no specific maximum established. The loan term is related to the life of the project, and the interest rate is the lesser of the municipal bond rate, or a rate that the Energy Division determines will allow the project to be financially feasible. There is also a companion grant program, and sometimes projects are implemented with matching funds from each program.

***Iowa Alternative Energy Loan Program*** - This revolving fund loan program provides interest-free loans for up to half of a project's costs, to a maximum of $250,000. Proponents must obtain financing from other sources for the remaining project cost. This has become a good partnership between the government and lending institutions. The government financing gives the lender a higher degree of security, and the lender does the credit checking. The effective interest rate for the proponent can be as low as half the commercial rate, depending on the total cost of the project and therefore the proportion of government funds. Some eight loans are underway at this time, all in repayment with no defaults, for projects ranging in size from $23,000 to $3 million.

The residential, commercial and industrial sectors are all eligible for this program. The program has general goals for the percentage of funds that will go to various types of green power, which include wind, methane, and biomass, hydro and solar. Most projects to date have been wind, including applications with an education component at some community schools. The program is financed by an allocation of $1.8 million per year for three years (to 1999) by the states' investor-owned utility. The Iowa Energy Center, the government's research and development agency operated out of Iowa State University, administers it.

**Green Power Certification**

Green power certification is the process of assessing and approving a green power source as a legitimate qualifier for a given program, such as green power rates and procurement programs discussed below. The U.S. has implemented various certification programs. Disclosure by utilities of their green power sources is of utmost importance in the credibility of green power marketing programs.

***Environmental Choice Program*** - Environment Canada through a service delivery contract with an independent organization, Terrachoice Environmental Services Inc, administers the Environmental Choice Program (ECP). The ECP provides a life-cycle assessment of products, services, technologies, and processes, operations and facilities that are less harmful to the environment. Criteria and guidelines for certification have been developed and certain products may undergo a panel review as part of the certification process. To date, about 2000 products within some 100-product categories bear the EcoLogo symbol of certification in their product labeling or marketing materials.

***Alternative Source Electricity Generation*** is a relatively new part of the Environmental Choice Program. Four sites have been certified to date and between 20 and 30 applications are in the process. The definition of eligible green power and the associated guidelines (including performance criteria) will be revised after stakeholder consultations in 1999. Power generation technologies now eligible for consideration include:

- waste energy recovery (e.g., landfill methane);
- solar (e.g., photovoltaics, active solar, passive solar);
- water (20 MW or less run-of-river hydro facilities);
- wind (individual or small-to-medium wind farms);
- biomass (e.g., remote-site sawmill waste-wood); and
- other (e.g., hydrogen fuel cells).

Obtaining the right to use the logo is important to businesses selling green products and marketing a green image, as consumers recognize the independent "stamp of approval."

**Green Power Set-Aside**

Green power set-asides, or Renewable Portfolio Standards, commit or require utilities to produce a specified portion of their electricity, or a percentage of their total capacity, as green power. In some cases, utilities have voluntarily adopted such standards. More often, utilities are mandated to do so as part of electricity market deregulation. This is to ensure that a minimum portion of new capacity comes from green power, which still tends to cost more than conventional alternatives. Without a utility regulator to require

that environmental factors be considered or that integrated resource planning be done, and with the proliferation of competing energy providers, it becomes important to ensure that green power gains and retains a given percentage of the supply portfolio. Regardless of deregulation, it is still valid for a utility to commit to a green power set-aside for numerous other reasons, including energy diversification, response to climate change concerns, and preparation for possible future deregulation. Some examples follow.

***Hydro Quebec - Proposed Wind Portfolio Standard*** – In October 1998, the provincial energy regulator in Quebec recommended that the provincial government institute a set-aside of 50 MW of installed wind power per year for nine years, starting in 2002. The main rationale was to create a new industry in the province around the manufacture of wind turbines in order to become a continental leader in this technology and benefit from exports to other jurisdictions. The proposed plan is to create a reserve account from a share of the annual dividends from Hydro Quebec to the Government of Quebec. The price premium required for the wind power would be covered by this reserve account, and a rate increase would not be required. The price premium would be controlled by setting a ceiling price for the wind power, proposed at the maximum price paid for wind electricity generated by the 100 MW Le Nordais project in the Gaspe (about 5.8 cents per kWh), scheduled to go into service in December 1999.

This standard is a proposal at this stage. Various U.S. states have already established Renewable Portfolio Standards ranging from 1 to 30 percent of electricity sales over time, with different levels, timeframes and definitions of renewables.

***U.S. Portfolio Standards*** - Several states have adopted Renewable Energy Portfolio Standards as part of their electricity market restructuring legislation, each with its own characteristics.

- Arizona requires that 0.5% of all power sold in 1999 and beyond must be derived from a solar resource (photovoltaic or solar thermal source), with the standard raised to 1% in the year 2002.
- Connecticut requires that 13% of all supply in 2009 be derived by renewable energy, including hydroelectricity, with certain limits to ensure that other sources are developed as well.
- Iowa has a renewable energy-purchasing requirement.
- Massachusetts requires that 1% of all power sold in 2003 be derived from renewables, increasing to 5% by 2010, and 1% per year after that.
- Maine requires that 30% of all retail sales be provided by renewable resources, including hydro, fuel cells, and municipal solid waste in conjunction with recycling.
- Nevada requires that 1% of electricity consumption in the State be derived from renewable resources in 2010 (0.2% prior to that), half of that from solar resources.

- Vermont is considering a 7% Portfolio Standard.
- Wisconsin has a separate law that 50MW of new renewables be on-line by December 31, 2000.

Several federal proposals for portfolio standards have also been advocated for national application. The proposal by President Clinton would require that 5.5 percent of all electricity sold in the U.S. be derived from non-hydroelectric, renewable resources such as wind, solar, biomass, or geothermal sources by the year 2010, subject to a cost-impact cap. There would be an intermediate target for 2005. The policy would also establish a national market for renewable energy credits. Provided that a liquid market is established, the tradability option would ensure that the most cost-effective resources are developed in the country. A national net metering proposal for such renewable energy sources would also enable the target to be met through private investments.

**Yukon Experience**

This section illustrates activities relating to green power installation (supply), currently or previously undertaken in the Yukon.

- About 12 small wind turbines are now operating in the Yukon.
- Yukon Energy has a producing wind facility of 0.2 MW.
- The recently announced Wind Research and Development Project, will result in the installation of an additional turbine on the Whitehorse-Aishihik-Faro (WAF) grid.
- Some remote homes, telecommunications firms, highway maintenance camps and park interpretive centres are using photovoltaics.
- In downtown Whitehorse, the Gold Rush Inn has solar hot water heating, and there are solar collectors for space heating at the former Crossroads building.
- Several privately owned micro-hydro systems are in place.
- Geothermal reservoirs have been mapped out, but used to a minimal extent to date.
- The Rural Electrification Program (1998) is supporting installation of alternative (renewable) energy systems by property owners outside municipalities.

Green power investments are being encouraged in most North American jurisdictions through various financial, market, tax and regulatory mechanisms. Yukon green power proponents can already take advantage of several federal programs and tax measures and can participate in emissions trading mechanisms. Furthermore, much can be learned from the experience of other jurisdictions that have applied similar instruments.

Due to the structure of the Canadian and Yukon tax systems, any tax measures are more likely achieved through the federal system rather than through territorial taxes. Given the continuing regulatory environment in the electricity market, a green power set-aside

could be adopted for all new capacity to be added by Yukon Energy. A mechanism or formula would have to be developed to establish an appropriate set-aside target that would address both fluctuations in demand and the intermittent nature of green energy sources such as wind. A Yukon emissions program is not likely to have enough participants to "go alone" and would likely be better off connected to a broader framework such as the national ***Credit for Early Action***, or the ***GERT Pilot***. Some resources could be put to work indefinitely in the form of a revolving loan fund for green power investments, including a financial mechanism to encourage off-grid communities to convert from diesel to green energy.

In general, good results can be achieved through partnerships between parties, such as utilities, independent power producers, government, consumers, non-government organizations, and private sector lending institutions, by levering funds and applying the varied expertise available.

This category includes mechanisms to enhance consumer demand and purchases of green power and related technological products, focusing on consumer choice. More and more green power products and services are being marketed, particularly in North America and Europe. Green power is being offered and purchased through differentiated rates, green power marketing initiatives and net billing, and other mechanisms such as capital cost and production rebates, and capital loans and tax breaks.

These instruments are aimed at:

- making green power choices accessible to consumers through marketing;
- developing robust green power markets including many suppliers and consumers;
- inducing green power purchases beyond initial market penetration; and
- providing access to or levering capital funds for the consumer's initial investment in green power technologies.

**Green Power Purchasing**

Green power purchasing or procurement programs use large purchases of green power to initiate market demand for this power in sufficient quantities to achieve the following objectives:

- reduce risk for supplier(s) and make project(s) viable;
- enable green power installations to be built;
- reduce costs of supplying the power by providing economies of scale; and
- lead the way for other power customers to follow suit.

The purchases of power may come in the form of contracted commitments from large institutions, or from buying groups of commercial customers. An example follows.

The ***Government of Canada Green Power Purchasing Pilot*** - The federal government's Green Power Purchasing Pilot was launched in 1996. The objective is to provide market opportunities for renewable energy technologies that are ready to compete on a commercial or near-commercial basis with established power sources. Environment Canada has committed to purchasing 15-20 percent of its electricity as green power by 2010; only one purchase agreement in place to date: NRCan and Environment Canada

have committed to purchase 10,000 MWh and 2,000 MWh respectively of green power per year for 10 years beginning in 1997. These levels meet most of the electricity requirements of the Alberta facilities of the two departments. The purchase agreement is with ENMAX of Calgary, who in turn buys the green power off the grid at a premium price, from Vision Quest Wind-electric and a biomass plant. To qualify, the electricity must meet and maintain EcoLogo certification and be generated from new capacity. Environment Canada is assuming ownership of the related greenhouse gas emission reduction credits as part of a pilot project to monitor and register such credits.

**Green Power Rates**

Green power marketing refers primarily to the charging of higher rates for a differentiated product, namely power produced from green sources. This is generally being done where electricity market restructuring has resulted in deregulation and competitive electricity markets, and where a Renewable Portfolio Standard has not been adopted.

A portion of a utility's power generation is or must be green, and this product is marketed to consumers willing to pay a price premium for quasi-ownership of some of those green sources, although the electricity used may not come from such facilities. Some electricity providers are inviting fixed payment on each bill to generate funds for future green electricity products not tied to the customers' electricity consumption; others offer a proportion of their customers' consumption to be derived from green power at a higher price. Rebates against these higher green power rates may be offered to customers by the government, as was done by California, to induce initial demand. Examples follow.

***GREENMAX Green Power Rates – ENMAX*** (City of Calgary) - ENMAX, the City of Calgary's electric system, started its GREENMAX program in September 1998. This green power marketing program was aimed initially at residential customers and will be expanded to include commercial customers in 1999. There are currently two base rates available: $7.50 per month for a 125-kWh block of green electricity, and $15.00 per month for 250 kWh. The green power is produced by the Pincher Creek wind facilities of Vision Quest. The program was launched with a billboard campaign and customer response has exceeded expectations, with 1000 blocks having been sold by December 1998. Local wind energy companies have been involved in public education for at least a decade. Also, the marketing effort helped to create demand, as well as provide public education that helps promote long term market development. The commercial aspect of the program is not fully designed yet; it may begin with a few leading companies and build from there. Ownership of the resulting emission credits had not been resolved at the time this report was prepared.

***Selected U.S. Green Rates*** - A number of green rate programs now being marketed in the U.S. allow utility customers to choose to pay for a green power option. The programs may be structured around a green tariff (a surcharge per kWh), a specified fixed monthly payment, or a contribution determined by the customer. Below are some examples.

- ***Green Mountain*** offers three power blends in California and three others in Pennsylvania. Two of the California products include small-scale hydro, biomass, and geothermal, and a small amount of large hydro (not specified). Their defining features are:
  a) wind for the future – up to 10 % will come from wind turbines;
  b) 75% renewable power – 75% from renewable sources.
  Customers with a $50 per month bill would tend to pay about $10 per month more for the first option and over $5 per month for the second.
- ***Traverse City Light and Power*** is a municipally owned utility of 8,000 customers (6,800 residential) in Michigan. A green tariff of some 20 percent above standard rates was applied to help finance a 600kW wind turbine. Residential customers were asked to commit for a three-year period and commercial customers to commit for ten years. With the marketing program, the utility was able to get adequate commitments; the utility then contracted with the supplier and covered the initial project costs so customers did not pay until the power was produced. Any future fuel cost adjustments to the standard rates will not be applied to green rate customers. This green rate is one of the most successful in the US, receiving a customer uptake of about three percent.

**Green Energy Product Rebates and Technology Financing**

Rebates on the purchase price of green power devices and components, such as solar modules and inverters could be set up. These could be patterned after the PowerSmart energy efficiency products program. Other examples follow.

***Renewable Energy Deployment Initiative – Natural Resources Canada*** - The Natural Resources Canada Renewable Energy Deployment Initiative (REDI) is a three-year program that stared in May 1998 to encourage heating and cooling using renewable energy. The program began with solar air, solar water, and biomass combustion, and includes ground-source heat pumps for some program aspects (but not the financing incentives described here). The program provides direct financial incentives to prospective participants: a direct contribution of 25 percent of the purchase and installation costs, up to $50,000 per project and $200,000 total per proponent. The program is geared towards business, and 10 percent of the total annual budget ($4 million) is allocated to federal government purchases. Funding is provided to demonstration projects so as not to decrease prices or distort the market.

***REDI*** has other components in which the government works with partners to conduct market research studies, develop marketing strategies, and conduct training, deliver information campaigns regarding renewable energy systems.

***Idaho Alternative Energy Tax Deduction*** - The State of Idaho passed a statute about 20 years ago that allows for a personal income tax deduction for residential green energy investments. Solar, wind and geothermal technologies used for heating or electricity generation are eligible. Also, a non-certified wood stove may be replaced with an EPA-certified wood stove or pellet stove, or a natural gas or propane heating unit. The statute allows an income tax deduction of 40 percent of the cost of eligible devices in the year installed, and 20 percent per year over the next three years, with a maximum deduction of $5,000 per year. With a state population of one million, about $2 million per year has been claimed under this program.

***West Kootenay Power Heat Pump Financing Program*** - The West Kootenay Power Heat Pump Financing Program currently applies to ground-source heat pumps; next year the program will be expanded to include air-source heat pumps. The program is geared to help potential buyers get over the hurdle of the initial investment in the technology. It is aimed at the one-third of utility customers who do not have access to natural gas heating, and therefore tend to rely on electric heating. The utility estimates the energy savings that would accrue compared to resistance heating, and provide a rebate to the customer of one cent per kilowatt-hour. (This represents 40 percent of the utility's long term avoided supply cost.) Based on an average of 10,000 to 15,000 kWh per year in savings (which have been verified after-the-fact), the total rebate to a customer is typically $1,000 to $1,500 over 10 years. Only 150 heat pump rebates have been provided, as the up-front costs of $8,000 to $12,000 result in a payback of 5 to 8 years for customers; therefore, the program tends to apply to those who know they will be staying in that home for at least that long.

West Kootenay Power is just initiating time-of-use rates. As a companion measure, they are going to provide low-interest loans of $2,500 toward electric thermal storage, to reduce customers' use of peak electricity. The real savings to customers will be in the time-of-use rates, but the companion program will enable and encourage them to participate.

**Net Metering**

Net metering (also referred to as net billing, reverse metering, or power banking) allows utility customers to produce some of their own power and "bank" it on the utility system for later use. To the extent they produce power, the amount generated and fed to the grid is deducted from their utility bill(s) for a given period. In this way, customer-producers

can feed the grid when excess power is produced and consume power from the grid when their production falls below consumption. They receive the retail rate (that they pay for power) for the power produced, and may net their bill down to zero. Some utilities will also buy the excess power, often at a wholesale rate or the utilities avoided cost (of having to generate that power itself). Examples follow.

***Ontario Hydro/Toronto Hydro Net Billing Program*** - Ontario Hydro (OH) established a net billing pilot project in 1997 and Toronto Hydro (TH) followed with a virtually identical pilot. Under the OH/TH programs, eligible renewable energy technologies include photovoltaic solar, wind, micro-hydro (OH only), and biomass (OH only) technologies of up to 50kW capacity. The OH program limits the number of connections to 20 systems while TH has full discretion for the number of systems that can be connected. Customers receive the retail rate of electricity for all excess electricity they produce. Customers are able to "bank" electrons in the grid for a whole year rather than be limited to a specific billing period. At the end of the year, the total net production is subtracted from total net consumption to determine the amount owed from the customer, if any. The bi-monthly bill uses an annual 'profile' of the customer's expected net consumption and production, which is adjusted at year-end when amounts are determined.

Both programs have had a reasonable customer uptake in the first year. It should be noted that Ontario Hydro does not serve many urban customers, as there are approximately 255 municipal and 4 private utilities in the province (including Toronto Hydro) to service those loads. The Ontario Hydro program has at least six connections:

- an 80kW Lagerway wind generator, restricted to 50kW, installed by the Blind River municipality (partly using extra monies from a redevelopment fund that resulted from the closing of a uranium mine in the Elliot Lake region);
- a 50kW Atlantic Orient Canada wind generator, at the Town of Blind River marina;
- a small scale solar PV in a rural setting;
- a 400 Watt (average) solar PV installation;
- a micro-hydro development in the Town of Blind River; and
- a wind and solar system (including solar shingles) to power parking lot lights at the Kortright Centre for Conservation northwest of Toronto.

***Manitoba Hydro*** - Manitoba Hydro has had a generous net metering program in place since 1989. It does not focus exclusively on sustainable sources, but includes all non-utility generation, including cogeneration. For purchases under 2,000 kW, Manitoba Hydro will pay the same rates it charges its customers for similar services. Customers can reduce their bill, net it out to zero, or even receive a cheque if their overall production exceeds consumption. For purchases over 2 MW, Manitoba Hydro will pay the avoided system cost, or some other value determined by the corporation. Despite its features, the program has had very low uptake to date, due primarily to the low electricity prices in Manitoba – about 5 cents per kWh for residential customers.

***Selected U.S. Net Metering Programs*** - Many net metering programs are in place across the United States, with varying program specifications. Two programs are described below.

***Washington State*** enacted a net metering law in March 1998, requiring all electric utilities to offer net metering programs to customers on a first-come first-served basis until the cumulative generating capacity of the net metering systems equals 0.1 percent of the utility's peak demand during 1996. Customers qualify if they have installed small generating systems (capacity under 25kW) that use solar, wind and hydropower, and are intended primarily to offset part or all of the customer-generator's requirements for electricity. As with all net metering programs, specific technical standards and safety requirements apply.

The ***Public Service Commission of Wisconsin*** authorized net metering in 1993, and applied it to all utilities under the commission's jurisdiction. In addition, several rural electric co-operatives are voluntarily offering net metering programs. The Wisconsin programs apply to customer-owned electricity generation facilities under 20kW, regardless of energy source. The utility's electric meter runs backward when the customer is generating electric power to feed into the utility grid. If the amount of energy supplied to the utility exceeds the amount of energy consumed, customers will receive a credit on their monthly bill. For renewable resource generators, the energy credit rate is the customer's retail rate. For nonrenewable resource generators, the energy credit rate is the utilities avoided cost.

**Yukon Experience**

This section illustrates activities relating to green power marketing, currently or previously undertaken in the Yukon.

- *Yukon Housing Corporation* operates a series of programs focused on energy efficiency: Energuide for Houses, R-2000, Home Repair Program, Residential Electricity Management Program, and a Commercial Electricity Management Program.
- The *Rural Electrification Program* (1998) provides low-cost financing for installation of alternative (renewable) energy systems for property owners outside municipalities.

When the wind generation project announced last fall is connected to the grid, it may be appropriate to proceed with a green energy rate. A major customer could be encouraged to purchase a certain portion of the power generated and the rest could be offered to residential and commercial customers.

Any green rate option should apply product certification standards such as the Eco-Logo or equivalent, to ensure that all power produced meets national standards for the definition of green power. These standards are designed to guarantee the environmental effectiveness of green power investments and maintain public and stakeholder support for green rates.

A net metering program with a pre-imposed capacity limit would be very useful for smaller communities and rural areas where diesel generation or no service is the norm. Customers could set up their own individual household or business wind or micro-hydro system. They would draw from the grid as required and could 'bank' excess power produced from their own system. Net metering could also apply to the Whitehorse-Aishihik- Faro grid even though there is very little diesel peaking when the Faro mine is not operating. Again, it should be limited to a small percentage of the total system capacity depending on the Faro situation. This would protect the security of the system by not over-committing to green power and would limit negative financial impacts associated with 'stranding' diesel and other supply assets.

# *Yukon Green Power Initiative - References*

***Background Paper #7***

**Alaska Power Project Revolving Loan Fund.** The state loan program for financing green electricity projects. Contact: Percy Frisby, Alaska Department of Community and Regional Affairs, Division of Energy, Anchorage, Alaska. tel: 907-269-4628

**Alberta Renewable Energy Test Site (ARETS).** This financially autonomous test site for wind and solar agricultural applications received early-stage funding from Alberta government programs described in this report. *Contact: Rick Atkins, tel: 403-329-1212*

**American Solar Energy Society (ASES).** Society promoting solar energy in the U.S. and providing networking functions. *Internet:* http://www.ases.org

**American Wind Energy Association (AWEA).** AWEA advocates the development of wind energy and provides networking for members. Their website includes technical papers and information, policy information and related publications. *Internet:* http://www.igc.org/awea

**BC PST Exemption.** This exemption from provincial sales tax applies to certain renewable energy technology products, including generating equipment and associated items and components (except for batteries) for: wind, solar, and micro-hydro. *Contact: Ministry of Finance and Corporate Relations*

**BC Hydro.** The government-owned regulated utility in BC has an Energy Futures Coordinating Committee that looks into long range planning and emerging markets for green energy and energy efficiency initiatives. *Contact: Peter Mulvihill, tel: 604-632-4337*

**BC Hydro Home Improvement Program.** Loans for energy efficiency retrofits in the residential sector. *tel: 604-540-8883*

**British Columbia Institute of Technology (BCIT).** The BCIT has a set of solar panels on one of its campus buildings, from which a net metering demonstration project is being conducted with BC Hydro. Besides net metering, the project has a training component. *Contact: Ljubisav Stamenic, Project Manager, BCIT Technology Centre, tel: 604-451-6934*

**California Consumer Credits.** Customers of California's major grid-connected utilities automatically receive a 1.5 cent per kWh credit if they switch their power purchases to a

registered non-utility electricity service provider selling Energy Commission approved renewable power.

This and the buy-down program (below) are funded from an energy surcharge. *Contact: Vince Shwent, California Energy Commission, tel: 916-653-1063. Internet:* http://www.energy.ca.gov

**California Emerging Renewables Buy-Down Program**. This program provides a rebate to residences and small businesses of up to half the cost of eligible components of grid-connected small wind turbines, solar thermal equipment, photovoltaics, and fuel cells. *Contact: Vince Shwent, California Energy Commission, tel: 916-653-1063. Internet:* http://www.energy.ca.gov

**Canada Trust EnviroMortgage.** People who purchase an R-2000 energy efficient home may be eligible for this mortgage, and therefore receive a credit of 2% of the principal mortgage amount. Canada Trust also provides Enviro-Loans through the Green Communities Program, for energy efficiency renovations. *Contact: Canada Trust product information, tel: 1-800-668-8888*

**Canadian Association for Renewable Energy (CARE).** This association puts out a very informative, free news update on renewable energy activities around the world called "Trends in Renewable Energies". *Contact: Bill Eggertson Internet:* http://www.renewables.ca

**Canadian Earth Energy Association**. Association promoting geothermal energy and related devices (e.g., ground-source heat pumps). *Internet:* http://www.earthenergy.org

**Canadian Electricity Association (CEA).** Canada's association of electric utilities, providing and exchanging information on the industry. *Contact: tel: 514-937-6181. Internet:* www.canelect.ca/cea

***Canadian Energy Efficiency Alliance.*** Internet: ***http://www.web.net/~ceea/index.htm***

**Canadian Guide to Energy Efficiency and Renewable Energy**. Electronic resource database produced by Natural Resources Canada. *Internet:* http://www.nrcan.gc.ca

**Canadian Solar Industries Association (CanSIA).** This is the industry association for companies involved in the solar industry in Canada. They coordinate members' efforts, lobby for fair treatment from government, and run seminars and workshops (see below). *Contact: Alexa Pritchard, tel: 613-736-9077. Internet:*
http://www.newenergy.org/newenergy/cansia.html

**Canadian Wind Energy Association (CanWEA).** CanWEA is Canada's association of wind energy operators and proponents, who work toward the development of the wind energy resource, including running courses and conferences and providing a quarterly newsletter "Windsight" and the Canadian Wind Energy Directory. *Contact: Jim Salmon, tel: 1-800-9CanWEA. Internet:* http://www.canwea.ca

**Center for Renewable Energy and Sustainable Technology (CREST).** This organization produces educational material and has a very informative website named "Solstice" with a catalogue of annotated links to other renewable energy organizations, initiatives and websites. *Contact: Christopher Gronbeck, Seattle, Washington tel: 206-729-5260. Internet:* http://solstice.crest.org/renewables/index.shtml

**Clean Energy Finance Newsletter.** This electronic newsletter provides news about renewable energy and energy efficiency investments in emerging markets; subscriptions are free. *Contact: Michael Philips, Energy Ventures International, Maryland, tel: 301-891-1010. Internet: see solstice.crest.org*

**Climate Change Action Fund.** This fund, established by the federal government, provides funding for public education and outreach projects related to climate change, and for Technology Early Action Measures (TEAM) that will lead to significant reductions in greenhouse gas emissions. *Contact: the TEAM office, tel: 613-996-6220. Internet:* www.climatechange.gc.ca

**Climate Change Secretariat.** Canada's Climate Change Secretariat is organizing the national process to revise Canada's National Action Program on Climate Change. *Contact: Anne-Marie Smart, Director General, Climate Change Bureau, Environment Canada, tel: 819-997-6826. Internet:* www.climatechange.gc.ca

**Compass Resource Management Ltd.** Consulting services on resource management and policy, environmental economics, community energy planning, green power, water management and others. *tel: 604-641-2875, Internet:* http://www.compassrm.bc.ca

**Database of State Incentives for Renewable Energy.** This database promotes renewable energy in business, industry and government. It features lists, descriptions and links to state incentives, programs, regulatory policies and related documents. The database may be searched by state, category (e.g., loan programs, net metering), sector (e.g., residential, commercial), and/or technology (e.g., wind, PV). *Internet:* http://www-solar.mck.ncsu.edu/dsire.html

**Dogrib Power Corporation.** One of the group of companies owned by the Dogrib First Nation, which owns a small hydro plant. *Contact: Al Jamal, tel: 867-873-6680, Ext. 1*

**Energy Alternatives.** Energy Alternatives is a BC business operation specializing in micro-hydro, wind and solar power. Products, services, energy systems, and design are offered, as well as micro-hydro system design and installation courses. *Contact: Bob Matthews, tel/fax: 250-679-8589*

**Energy Aware CEP - Tool Kit.** B.C.'s Energy Aware Committee prepared this Tool Kit for Community Energy Planning. It is a binder in three parts: (i) an introductory guide on the CEP process, (ii) ideas for CEP implementation and (iii) a detailed set of references

and resources. *Contact: Marie Crawford, Union of BC Municipalities, tel: 604-270-8226. Internet:* http://www.civicnet.gov.bc.ca/ubcm

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**Environmental Choice EcoLogo.** Canada's certification program for environmentally superior products and services; operated by an independent organization. *Contact: John Polak, Terrachoice Environmental Services, tel: 613-247-1900. Internet: http://www.cbsc.org/nb/bis1888.html*

**EPCOR.** Edmonton Power Corporation (EPCOR) has a PV installation integrated with their head office roof, and is collaborating on a residential PV demonstration project with one of their customers. *Contact: Tannis Tupper, tel: 780-412-7891*

**Green-e Certification.** The Green-e Renewable Energy Branding Program is a voluntary certification and verification program for environmentally preferred electricity products in the U.S., run by the Center for Resource Solutions. *Internet:* http://www.green-e.org

**Greenhouse Emissions Reduction Trading (GERT).** A consortium of government departments, private sector companies and others is operating this emissions trading pilot program. *Contact: Warren Bell, BC Ministry of Environment, tel: 250-387-4773. Internet:* http://www.gert.org

**GREENMAX.** This Green Rates Program is being operated by ENMAX, Calgary's electric system. Contact: Leon Burn, tel: 403-268-1227. Internet: *http://www.enmax.com*

**Green Mountain.** Contact tel: 1-888-246-6370. Internet: www.greenmountain.com

**Home Power Magazine.** A layperson's technical journal that covers all aspects of designing, developing, purchasing and utility interconnecting of green power systems. *tel: 530-475-0830, Internet:* http://www.homepower.com.

**Idaho Energy Tax Deductions.** Deductions from state income taxes for residential installation of green energy devices. *Contact: John Crockett, Idaho Department of Water Resources, Energy Division, tel: 208-327-7962*

**Independent Power Association of BC** *Contact: Paul Willis, President, tel: 604-685-2206*

Independent Power Producers Society of Alberta (IPPSA) ***tel: 403-282-8811***

**Independent Power Producers Society of Ontario (IPPSO).** This organization promotes independent power through public conferences, educational materials, interventions in public hearings, and through networking (including a database of suppliers and financiers) and producing a newsletter, "IPPSO Facto". *Contact: Jake Brooks, tel: 416-322-6549, Internet:* http://www.newenergy.org/newenergy

**International Solar Energy Society**. Among numerous activities to promote solar energy worldwide, is their journal "Sunworld." *Internet:* http://www.ises.org

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**Interstate Renewable Energy Council (IREC).** This U.S. Council coordinates efforts to accelerate renewable energy development in and through state and local government activities. *Internet:* http://www.eren.doe.gov/irec

**Iowa Alternative Energy Loan Program.** State loan program for investments in qualifying green power facilities. *Contact: Keith Kutz, Iowa Energy Center, tel: 515-294-8819. Internet: www.energy.iastate.edu*

**Kortright Centre for Conservation.** This environmental education centre near Toronto has a significant display of renewable energy technologies, including a demonstration cottage that derives all its energy from solar and wind. *tel: 905-832-2289. Internet:* www.kortright.org

**Lilloet Swimming Pool.** This project put into practice the concept of Green Energy Service Companies (GESCOs). *Contact: Joe Thwaites, Taylor Munro Energy Systems, tel: 604-878-0285, Internet: http://www.direct.ca/taylor-munro*

**Manitoba Hydro – Net Metering.** Manitoba Hydro has a net metering program for small IPPs or individuals with wind, solar, or micro-hydro systems under 2 MW. The meter runs backwards when surplus electricity is fed to the system, and customers can net their bill out to zero, or receive a cheque if they produce more than they use over a given period. *Contact: Tom Molinsky, tel: 204-474-3311. Internet:* http://www.hydro.mb.ca

**Natural Resources Canada.** The federal department has a number of programs and offices; of particular relevance are the ones described in the body of the report, listed below with their contact information.

**Renewable and Electrical Energy Division (REED)** *Internet: http://www.nrcan.gc.ca*
**Renewable Energy Technology Program.** *Contact: Claude Barraud, tel: 613-996-6087.*

**Renewable Energy Deployment Initiative (REDI).** *Contact: Richard Godin, tel: 613-992-9845 or Denis Zborowski 613-947-9815*

**Green Power Purchase Pilot.** *Contact: Dierdre Hetherington, tel: 613-995-0087, or Leslie Welsh at Environment Canada.*
*Class 34 / 43.1 Secretariat tel: 613-996-0890.*

**Directory of Efficiency and Alternative Energy Programs in Canada**. *To order, contact: 1-800-387-2000, or available on Internet.*

*CANMET: Internet: http://www.cedrl.mets.nrcan.gc.ca*

**Energy Diversification Research Lab** (EDRL). *Contact: Andre Filion, tel: 450-652-5995.*

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**Renewable Energy in Remote Communities**. *Contact: Greg Leng, tel: 450-652-5154.*

**PV for the North.** *Contact: Sylvain Martel, tel: 450-652-6747.*

**National Renewable Energy Lab (NREL).** The U.S. NREL conducts research and has much information on renewable energy technologies. They have a green energy website, which is an Energy Efficiency and Renewable Energy Network. *Internet:* http://www.eren.doe.gov/greenpower

**Northwest Territories Power Corporation (NWTPC).** Electric utility for the NWT, including wind and district energy systems. *Contact: Tim Farrell, tel: 867-669-3300*
***NWT PV.*** *Demonstration PV units operating in Inuvik and Iqaluit. Contact: Sylvain Martel, CANMET, tel: 450-652-6747*

**Ontario Hydro - Net Billing Program.** Ontario Hydro started a net billing pilot project in 1997, as part of its Renewable Energy Technology Program. Customers can receive credits against their bills for excess electricity provided by eligible PV, wind, micro-hydro or biomass systems. *Contact: Jeanette Boyer, tel: 416-506-5238*

**Pembina Institute for Appropriate Development.** The Pembina Institute undertakes a variety of activities on renewable energy, energy efficiency, and climate change, and prepared this report. *Contact: Rob Macintosh, tel: 780-542-6272. Internet:* http://www.pembina.org

**Photovoltaic News**. The most comprehensive journal on photovolataic technologies and policy. *Internet:* http://www.pvenergy.com

**Photovoltaics in Cold Climates.** This book, edited by M. Ross and J. Royer, reports on the findings of the NRCan "PV for the North" project. It was published by James & James, December 1998

**PowerSmart.** The PowerSmart program had a series of product rebates available for energy efficient products including low-flow showerheads, compact fluorescent light bulbs and automobile power timer cords. *Internet:* http://www.bchydro.bc.ca

**Purcell Lodge.** BC Lodge where micro-hydro replaced diesel power generation. *Contact: Robert Mathews, President, Energy Alternatives Ltd., phone/fax: (250) 679-8589*

**Quebec Ministry of Natural Resources.** This provincial ministry is responsible for the renewable energy research and development program. *Contact: Benoit Drolet, tel: 418-627-6380 ext. 8118*

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**Quebec Wind Energy Set-Aside.** The provincial energy regulator has recommended that the government advise the Crown utility to set-aside a certain amount of new power development as wind projects in the next 3-5 years. *Contact: Eric Arsenault, La Regie de l'Energie*

**Renewable Energy – Sources for Fuels and Electricity**. Comprehensive technical book on green power. Authors: Johansson, Kelly, Reddy, and Williams. Island Press, Washington, 1993

**Renewable Energy Policy Project**. Excellent source of information on renewable energy policy issues. *Internet* http://www.repp.org

**Renewable Energy Today**. Daily information source on news related to renewable energy. *Internet:* eineditor@mindspring.com

**Rocky Mountain Institute**. RMI promotes environmental sustainability with a particular focus on energy efficiency. *Internet:* http://www.rmi.org

**Sacramento Municipal Utility District.** SMUD offers green rates and a "PV Pioneer" program (fixed rate per month). *Internet: www.smud.org/green*

**Simon Fraser University – Energy Research Group.** Academic research group that focuses on the energy sector – industrial energy efficiency, electricity policy, residential and commercial sector energy efficiency, greenhouse gas management, and transportation demand management. Strong emphasis on computer models to analyze implications of policy options. *Internet:* http://www.erg.sfu.ca. *See newsletter at* http://fas.sfu.ca/rem/ERG/ergnews9.html

**Solar Energy International (SEI).** This Colorado-based organization is dedicated to renewable energy education, and holds a number of intensive workshops each year. *Internet:* http://www.solarenergy.org

**Solar Energy Society of Canada Inc. (SESCI)**. This organization works to increase awareness and to promote renewable energy technologies in Canada. They produce the Canadian Renewable Energy Guide and the journal "Sol." The proceedings from the 1995 SESCI conference in Toronto include a paper by S. Martel and E. Usher entitled "The Value of Using Photovoltaics to Displace Fossil Fuel Consumption on NWT Diesel-Electric Grids". *Contact: Sheila McKirdy, tel. 613-234-4151. Internet:* http://www.solarenergysociety.ca

**Sustainable Development Research Institute**. *Vancouver. Internet* : http://www.sdri.ubc.ca

**Traverse City Light and Power.** This Michigan utility has a green rate program. See Internet description at http://eren.doe.gov/greenpower/aceee2.html

**Toronto Hydro Net Billing Program.** This program enables customers to provide surplus electricity they produce to the grid, and reduce their electricity bills. *Contact: Joyce McLean, tel: 416-591-4686. Internet:* http://www.torontohydro.com

**Vision Quest Wind-Electric.** Vision Quest is an Alberta IPP with four 600-kW wind turbines near Pincher Creek in southwest Alberta. They provide electricity to the Calgary grid, for sale by ENMAX as green power through the GREENMAX program, and to the

federal government as part of their Green Power Procurement Program. Vision Quest also has emissions credits for sale. *Contact: Jason Edworthy, tel: 403-289-4553. Internet:* http://www.greenenergy.com

**Washington State Net Metering.** *Contact: Nancy Hirsh, Northwest Conservation Act Coalition, Seattle.*

**WATSUN**. Solar energy analysis tool. *Internet* http://dial.uwaterloo.ca/~watsun/wslovvw.htm

**West Kootenay Power Heat Pump Financing Program**. This program assists homeowners with the up-front cost of obtaining a ground-source heat pump. *Contact: Keith Veerman, tel: 250-368-0388. Internet:* http://www.wkpower.com

**Wind Energy Monthly**. Comprehensive journal on wind power technology and policy. *Internet* http://www.wpm.co.nz

**Wisconsin Net Metering.** *Contact the Public Service Commission of Wisconsin.*

**World-Wide Information System for Renewable Energy (WIRE).** This is a non-profit project of the International Solar Energy Society (ISES). It is an on-line source of information on renewable energy, such as: conference proceedings, academic papers, case studies, upcoming conferences, and discussion groups. *Internet:* http://wire.ises.org

**Zephyr North.** A wind energy resource prospecting and monitoring company. Zephyr led the South West Alberta Renewable Energy Initiative (SWAREI) wind energy monitoring effort and prepared the final report for the SWAREI wind energy component. *Contact: Jim Salmon, tel: 905-335-9670; e-mail:* zephyr.north@sympatico.ca